

SOUTHERN SIERRA NEVADA FISHER AND MARTEN STUDY: PROGRESS REPORT IV

15 May 1994 - 2 October 1996

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Introduction

This report summarizes the field results of 2.5 years of continuous study of fishers (Martes pennanti and American martens (M. americana) in and around the Tule River Ranger District, Sequoia National Forest, Tulare County, California (Fig. 1). Here we report only the field results of Phase I of the research, which was intended to describe the habitat ecology, home range characteristics, and diet of fishers and of martens that are sympatric with fishers. Complete analysis, interpretation, and conclusions will be available in forthcoming drafts of manuscripts prepared for publication.

Field work for Phase I occurred from 13 May 1994 - 2 October 1996 and was directed by the Pacific Southwest Research Station of the USDA Forest Service. Phase II, under the direction of the Department of Environmental Science, Policy, and Management, University of California - Berkeley, will begin in the summer of 1997 with the goals of (1) developing regional habitat suitability models for fishers and martens in the southern Sierra Nevada, including areas outside our study area, (2) describing the breeding habitat of female fishers and the dispersal of their young, and (3) evaluating the potential for fishers to recolonize the central and northern Sierra Nevada.

Trapping and Captured Animals

During 21 trapping sessions 33 fishers and 33 martens were captured a total of 100 and 138 times, respectively. Fisher and marten were captured at the same trap site at 21 different locations, 17 of which were in the Camp Nelson area (Fig. 2). The sex ratio of fisher captures was biased toward females (11males:22 females) whereas marten captures favored males (25:8). Mean body weights for male and female fishers were 2.98 and 1.91 kg respectively, whereas male and female martens weighed 1.04 and 0.72 kg, respectively (Table 1). Fisher body temperatures were significantly higher than marten temperatures (Table 1). Twenty-four fishers (9:15) and 14 martens (11:4) were radio-collared. Ages were estimated from tooth cementum annuli, but only post-mortem. Mean age at death for fishers was 3.0 years ($n = 7$; range 0-6 years). The only confirmed marten mortality was of a 10 year-old female.

Resting Habitat

We located fishers at 338 rest sites on 408 occasions and martens at 155 rest sites on 208 occasions. Frequency of reuse of rest sites by martens (25.5 %) exceeded that by fishers (17.1 %). Twenty structures were used as rest sites by different individuals on different occasions; 13 fisher rest sites were later used by another fisher, 6 marten rest sites were later used by another marten, and 1 rest site was used by a fisher and a marten. One fisher rest site was used by three different female fishers. Fisher rest sites were at significantly lower elevations ($\bar{x}$ = 1673 m) than marten rest sites (1870 m); a result that would have been even more pronounced had we not limited our marten sample to individuals that occurred at relatively low elevations where fishers were most common.

Fishers rested most frequently in cavities, broken-tops, nests and on branches of standing trees, especially in black oaks (*Quercus kelloggii*) (Fig. 3). Trees (live, snags, stumps, and "nests" [abandoned bird nest, mistletoe, or witch's broom]) comprised 83.1 % of the fisher rest sites. In contrast, only 36.4 % of the marten rest sites were in trees. Marten use of non-arboreal rest sites appears to be more common than reported for marten elsewhere in North America. When resting in trees, martens rested in conifers more than in hardwoods (70.5% vs. 29.5%) whereas fishers rested in hardwoods almost as frequently as in conifers (47.6% vs. 52.4%). In contrast to studies elsewhere, neither species exhibited a substantial shift in type of rest site used during summer versus winter, nor were there seasonal shifts in the elevations of rest sites. However, female fishers favored oak rest sites during the snow-free season (52.2% of tree rest sites) but conifer rest sites during the snow season (71.3% of tree rest sites).

Conifers (giant sequoia [*Sequoiadendron giganteum*] excluded) that provided broken-top or cavity rest sites for fishers averaged 105.4 cm dbh and for martens, 99.1 cm (Table 2). Hardwoods, and conifers that provided "nest" rest sites, averaged 67.3 cm dbh when used by fishers and 52.0 cm when used by martens.

Using the California Wildlife Habitat Relationships (CWHR) classification system, fishers and martens most frequently rested in size class 4, 5, and 6 Sierran Mixed Conifer (SMC) stands with >60% cover (Fig. 4, 5, 6). Fishers also frequently rested in Montane Hardwood Conifer (MHC) stands, and to a lesser extent Montane Hardwood (MHW) stands. Rest sites during the snow season tended to occur in Mixed Conifer stands whereas rest sites during the summer occurred more frequently in Mixed Hardwood/Conifer stands (Fig. 4).

Home Range

Minimum convex polygon home ranges were calculated for 13 fishers for which we collected a minimum of 15 locations/animal ($\bar{x} = 37.6$ locations/animal) and for 7 martens for which we collected a minimum of 14 locations/animal ($\bar{x} = 26.7$ locations/animal). The majority of locations were rest sites which we located on foot. A few of the fisher locations, particularly for males, were recorded from an airplane. Male fisher and marten home ranges were about 6 times and 3 times that of their female counterparts (Table 3; Fig. 7, 8). Male fisher home ranges included more high elevation ridges than did females (Fig. 7). During the course of the study 13 fisher home ranges were described that included all or part of the approximately 100 km² Camp Nelson portion of the study area (Fig. 7). Considering only those individuals that were assumed to be occupying the area at the same time, this intensively used area supported an estimated minimum density of about 1 fisher/10 km². This crude estimate may be conservative given that a few other fishers were captured in the Camp Nelson area but were not collared. A significant portion of all of the marten home ranges were included completely within the range of at least one fisher. The shape and differential use of home range area will be investigated in more detail in the future, using adaptive kernel methods.

Limited data suggest that male fishers may make forays to investigate baits and lures more than do female fishers. Two of the 4 (50%) male fishers that were monitored long enough to determine their home ranges, were first captured at the perimeter of their home range. In contrast, most of the female fishers that were monitored (6 of 8; 75%) were first captured at locations in the central portion of their range.

Habitat Selection

A total of 374 rest sites (252 fisher and 122 marten) were the focus of detailed sampling to quantify the characteristics of the rest structures and their immediate vicinity. The attributes of forest structure surrounding fisher rest sites will be compared to vegetation attributes at a sample of random ("available") locations within their home ranges. During the summer of 1996, vegetation was sampled at random points within the home ranges of the 12 fishers that had been relocated at least 20 times. Data from these "focal" individuals will be used to evaluate habitat selection within home ranges. The area used by the focal fishers also included portions of seven marten home ranges, but as marten ecology was a secondary

objective of the work we were unable to conduct all the sampling necessary to evaluate the habitat available within focal marten home ranges.

Our design for sampling habitat availability involved randomly generating points within the home range of focal animals, each of which served as the basis for two sample points; one of these was the random point itself while the other was centered on a nearby tree or log ("structure") which met minimum size criterion defined by rest sites used by fishers. A total of 194 pairs of points were sampled during 1996. These data will permit us to contrast selection for forest types within fisher home ranges that are used for resting with selection for the features of forest structure in the immediate vicinity of the rest structure.

Habitat selection will also be assessed using a GIS to characterize the forest types, tree sizes, canopy closure, and other landscape attributes that compose fisher and marten home ranges; these will be compared to the study area at large. We also plan to use the GIS to conduct buffer analyses, where forest composition surrounding rest sites will be contrasted with areas around randomly generated points. In addition, we will test whether resting locations differ from random points in regard to distance to streamcourses and roads. The vegetation layers for these analyses are being developed from Landsat imagery at the Center for the Assessment and Monitoring of Forest and Environmental Resources (CAMFER) at University of California -Berkeley. Field verification of remotely sensed data began during the summer of 1996 and will conclude during the summer of 1997.

Reproduction

Five natal dens (where young were presumed to have been born) of three different females were located in 1995 and 1996. (Table 4). Careful monitoring of females during the spring was necessary to call a site a natal den, because kits were never seen during this period. The location of each adult female was verified twice per week, beginning in February, so that we could detect a change in rest site use pattern. We defined a natal den as a site a female used exclusively for at least two weeks (when monitored every other day), between 1 March and 1 May. Furthermore, at least two weeks of data prior to and after this period were required to make sure that a variety of different sites were used prior to and after the presumed natal den period. All natal dens were in cavities in large diameter ($\bar{x} = 103.4$ cm) standing trees (three conifers and two oaks) in CWHR "dense" stands with a mean basal area of 292 ft²/acre (Table 4).

Mortality

Of the animals confirmed or suspected to have died during the course of the study, 11 (45.8%) were fishers and 2 (14.3%) were martens (Table 5). Of the fisher mortalities, 2 were probably due to predation by a mammal, one was possibly killed by a raptor, and one became trapped in an empty residential water tank. The remainder were unresolved, though intraspecific predation was suspected in one fisher death. One marten necropsy confirmed liver disease in a 10 year old individual. We had no evidence to suspect that any of our study animals were killed by vehicles, but one unmarked marten was found dead on a road during the course of our work. We did not observe or collect evidence to suspect that fishers killed martens.

Foraging locations probabilities of detection and other mammalian mesocarnivores

An extensive, systematic (2 km interval), track plate grid survey ($n = 83$ stations; Fig. 9) was run from July - November 1995. The survey was used to determine the locations of active or foraging fishers and martens, to estimate the probability of detecting fishers and martens whose home ranges included detection stations, and to determine the distribution of other species of mesocarnivores. Each track plate was checked weekly for 4 weeks. This effort resulted in the detection of fishers at 18 stations (Fig. 10), martens at 19 stations (Fig. 11), and fishers and martens both at 2 stations. At least 8 other species of carnivores were detected, with the gray fox (*Urocyon cinereoargenteus*) most commonly detected in forest types and at elevations where fishers were common (Fig. 12). Characteristics of sites that detected each of the most common carnivores are presented in Table 6.

The track plate survey also allowed us to estimate the probability of detecting animals that were radio-collared and whose general whereabouts were known. Of the 8 fishers whose home ranges at the time of the survey included at least one track plate location (or came within 200 m of a station), a fisher was detected within the range of 6 of them (75%) (Table 7). A fisher was detected at a station within all of the fisher home ranges that overlapped at least 3 stations. Marten tracks were detected at stations within 5 of 7 (71%) marten home ranges.

Diet

A total of 376 fisher scats and 140 marten scats were collected from captured animals, in track plate boxes and at rest sites. Of the fisher scats, 94 (25%) have been completely analyzed; a preliminary list of food items, ranked by frequency of occurrence, is reported in Table 8. The diet appears to include a diverse array of mammal, bird, reptile, insect, and plant material. Note especially the frequency of reptiles in the diet, particularly the alligator lizard (Elgaria sp.). A single scat included 23 alligator lizard feet.

Genetics

During the processing of all fishers and martens a small sample of tissue was collected at the site where the ear tag was attached. These samples became part of a larger study of the genetics of fishers and martens in the Pacific states, and in the case of fishers, throughout their range. The work was conducted by Dr. Ken Cullings and Ms. Sandy Koepf, a graduate student at San Francisco State University. The initial objective was to use the mitochondrial and nuclear DNA sequence data to establish familial relationships among study animals. However, when it became clear that mtDNA sequences were far less variable than necessary for this objective, the lack of variation itself (especially among fishers) became the story of interest. In particular, none of the fishers in the Sequoia study population differed in the sequence of bases that comprise the d-loop region of their mtDNA. However, a small sample of martens selected from across California (including several from the Sequoia study population) demonstrated significantly more variation than fishers. This result prompted us to propose that the very different biogeographic histories of martens and fishers in the western United States may be responsible for the lower variation in fishers than in martens. A paper summarizing this avenue of research has been submitted (Cullings, K., W., S. M. Koepf, and W J. Zielinski. "Mitochondria) d-loop DNA sequence diversity in fisher (Martes pennanti, Mustelidae): California, Maine and the Rocky Mountains"). New work is now underway to answer the original question of relatedness among study animals, using microsatellites; small (one to a few base) subunits of DNA that are repeated in tandem. The number of these repeats can differ, resulting in length variation that provides a higher resolution genetic technique for population studies than by sequencing mtDNA.

Final analyses and interpretation of the field data are underway and the conclusions of the study are being drafted in manuscripts for publication in peer-reviewed journals. The

publication of these papers will conclude Phase I of the Southern Sierra Nevada fisher and marten study. The results reported herein may be slightly different when all the analyses are complete, so we prefer that the data in this report is not cited without our permission. Thank you.

Acknowledgments

We are grateful to Skip Rouch and Kurt Wendelyn of Sequoia Crest, Inc. for their support and hospitality during our stay at Sequoia Crest, especially during the winter. Rich Anthes, pilot with California Fish and Game - Fresno, has been extremely cooperative helping us realize our goal of 1-2 flights per month to locate lost or inaccessible animals. We thank Irene Timossi, of the Department of Environmental Science, Policy, and Management, UC-Berkeley, for assistance in producing GIS maps and Peng Gong and Ruiliang Pu, also from Berkeley, for assistance in the interpretation of satellite images. Colin Lee and Elise Goldstein assisted recapture efforts, radio telemetry, and habitat sampling at Mountain Home State Forest. Ric Schlexer and Greg Schmidt, both associated with the Six Rivers Fisher Study in northern California, helped in the field and helped develop data forms, respectively. Chester Ogan, of the US Forest Service -Pacific Southwest Research Station, was extremely helpful in providing timely and efficient response to the needs of the field crews. Robin Galloway, Wildlife Biologist from the Tule River Ranger District, provided a tremendous amount of logistical support and time to help us coordinate field operations on countless occasions. Robin, with the help of Gia Martynn (also from the Tule River Ranger District), helped locate radio-collared animals. We also thank the entire staff of the Tule River Ranger District for their assistance and cooperation during the course of the study. Fisher scat analysis was facilitated by having access to the collections in the Vertebrate Museum of Zoology, Department of Biological Sciences, Humboldt State University made available by Paula Guthrie and Tim Lawlor. The project would not have been possible without the dedicated support of key members of the US Forest Service, California Department of Forestry and Fire Protection, US Fish and Wildlife Service and California Fish and Game. Especially deserving of recognition are Diane Macfarlane, Esther Burkett, Dave Dulitz, Amedee Brickey, Steve Anderson, Pat Manley, Linda Parker, and Del Pengilly.

Finally, we acknowledge the discomfort, fear, and inconvenience that our study animals have been subjected to during the course of our effort to understand their lives.

Table 1. Mean (SD) weight, length and body temperature of 33 fishers and 33 martens captured between May 1994 and October 1996. Juvenile animals are estimated to be ≤ 1 year old and mature animals are estimated to be ≥ 2 years old.

		Weight (kg)	Length (cm)	Body Temperature (°F)	
N				Initial	Final
FISHER				103.8 (0.89)	102.6 (1.17)
Female	22	1.91 (0.17)	87.6 (3.1)		
Adult		1.92 (0.17)	87.6 (3.4)		
Juvenile		1.86 (0.22)	88.0 (1.9)		
Male	11	2.98 (0.53)	96.2 (6.0)		
Adult		3.24 (0.44)	99.1 (4.1)		
Juvenile		2.52 (0.32)	91.1 (5.8)		
MARTENS				102.6 (0.85)	101.3 (1.21)
Female	8	0.72 (0.06)	56.9 (0.9)		
(no juvenile females)					
Male	25	1.04 (0.10)	63.3 (2.8)		
Adult		1.07 (0.08)	63.7 (2.8)		
Juvenile		0.87 (0.06)	61.6 (2.4)		

Table 2. Mean (SD) diameter at breast height (cm) for conifers and oaks that fishers and martens used as rest sites on the Southern Sierra Nevada Fisher and Marten Study, 13 May 1994 through 2 October 1996.

	n	Conifer Mean (SD)	n	Oak Mean (SD)
FISHER	188	105.4 (32.9) ¹	145	65.3 (21.3)
MARTEN	45	99.1 (27.5) ²	20	57.0 (14.1)

¹ Excludes 6 giant sequoias; mean (SD) including them is 110.6 (43.3) cm.

² Excludes 10 giant sequoias; mean (SD) including them is 161.6 (140.4)cm.

Table 3. Preliminary mean home ranges derived from resting locations and trap sites for 13 fishers and 11 martens in the southern Sierra Nevada study, March 13, 1994 through October 2, 1996. Mean number of points / home range is 37.6 for fishers and 26.7 for martens. MCP = 95% minimum convex polygon and AK = 95% adaptive kernel.

		hectares		acres	
		<u>mean</u>	<u>st. dev.</u>	<u>mean</u>	<u>st. dev.</u>
FISHER					
Females (n = 9)					
MCP		504.3	182.3	1245.6	450.3
AK		826.5	315.6	2041.5	779.53
Males (n = 4)					
MCP		2756.3	661.1	6808.1	1632.9
AK		5223.2	3410.3	12901.3	8422.7
MARTEN					
Females (n = 4)					
MCP		72.3	26.0	178.7	64.2
AK		133.0	52.8	328.5	130.4
Males (n = 7)					
MCP		220.3	98.4	544.1	243.0
AK		433.0	253.5	1069.5	626.1

Table 4. Presumed fisher natal dens, Southern Sierra Nevada Fisher and Marten Study, spring 1995 and 1996.

	From - Until	Tree Species	Topographic Position	DBH	Condition Class	CWHR ¹	Basal Area ((ft ² /acre)	Distance to Water (m)
MP04	31 Mar. - 2 May 1995	white fir	bench	148	snag	SMC6D	140	180
MP04	25 Mar. - 9 Apr. 1996	conifer	convex	112	snag	PPN3D	280	200
MP06	12 Apr. - 6 May 1995	white fir	draw bottom	82	live tree	SMC5D	280	220
MP07	28 Mar. -8 May 1995	black oak	concave	99	live tree	SMC6D	260	35
MP07	26 Mar. - 3 May 1996	black oak	convex	76	live tree	MHC5D	500	30

¹ California Wildlife Habitat Relations System.

Table 5. Chronological list of confirmed, or strongly suspected, mortalities during the Southern Sierra Nevada Fisher and Marten Study, 13 May 1994 through 2 October, 1996.

	Sex	Estimated Age at Capture	Date Remains Discovered	Last Know Alive	Remains	Suspected Cause of Death	Age at Death ¹
Fishers (n =11)							
MP15	female	adult	13 Feb. 1995	mid-Jan. 1995	dentary only	unknown	-
MP02	female	adult	9 Mar. 1995	late-Feb. 1995	right hind food	avian predation? ²	-
MP16	male	adult	13 Mar. 1995	10 Mar. 1995	collar only	mammalian predation? ³	-
MP19	female	juvenile	25 April 1995	2 April 1995	tail	unknown	-
MP03	female	adult	18 July 1995	Dec. 1994	entire carcass	exposure/starvation	5
MP24	female	adult	25 Sept. 1995	20 Aug. 1995	miscell.	skull/skel. unknown	6
MP21	female	adult	22 Nov. 1995	17 Oct. 1995	miscell.	skull/skel. unknown	1
MP01	male	adult	1 Dec. 1995	27 Oct. 1995	entire carcass	head trauma; predation?	2
MP30	female	juvenile	16 Jan. 1996	5 Dec. 1995	entire carcass	predation by mammal	0
MP05	male	adult	27 Mar. 1996	5 Feb. 1996	miscell. skull/skel.	unknown	4
MP06	female	adult	3 June 1996	17 May 1996	entire carcass	head trauma	3
Martens (n = 2)							
MA 01	female	adult	5 Jan. 1996	29 Nov. 1995	entire carcass	liver disease, age.	10
MA02	male	adult	not	14 July 1996	none	unknown	-

¹ Aged by counting cementum annuli of teeth removed from carcass.

² "?" indicates that the veterinarian conducting the necropsy was uncertain about the type of animal responsible.

³ Collar had puncture holes consistent with those made by the canines of a mesocarnivore, including fisher.

Table 6. Mean topographic and vegetation characteristics at track plate stations where fisher, marten, ringtail, spotted skunk, or gray fox were detected from July - November 1995.

	Fisher n = 18	Marten n = 18	Ringtail n = 9	Spotted Skunk n = 11	Gray Fox n = 15
Elevation (ft)	5120.0	6536.8	4783.3	4307.3	5618.7
Slope (percent)	45.6	35.0	55.2	34.1	47.6
Basal area (ft ² /acre)	170.0	212.6	131.1	107.3	187.5
Basal area - Conifers	130.0	190.5	35.5	54.5	117.5
Basal area - Hardwoods	40.0	22.1	95.5	52.7	70.0
Basal area - Snags	10.0	21.0	31.1	9.1	25.0
Basal area - Trees > 60 cm	54.4	93.6	13.3	30.9	42.0
Mean dbh (cm) ¹	54.2	71.4	32.5	58.3	43.4
Canopy closure (% via densiometer)	91.0	85.8	86.0	83.7	81.8

Table 7. Fisher and marten detections at track plate stations within, or 200 m from the edge of, the home range (95% minimum convex polygon) of 8 radio-collared fishers and 7 radio-collared martens during the late summer and fall of 1995. Each station was in place for 4 weeks and was checked and baited every week.

	Number of stations in home range area	Number of stations that received a detection	Proportion of stations with a detection
Fishers			
Male 01	8	3	0.37
Male 23	8	1	0.12
Male 05	9	2	0.22
Female 10	2	0	0
Female 07	2	0	0
Female 06	3	2	0.67
Female 21	3	1	0.33
Female 04	4	2	0.50
Martens			
Male 16	2	1	0.50
Male 02	1	0	0
Male 15	1	1	1.00
Male 19	2	1	0.50
Male 21	3	3	1.00
Female 01	1	0	0
Female 10	1	1	1.00

Table 8. Preliminary list of food items identified in fisher scats collected between May 1994 - October 1996. The list includes the contents of 94 scats that have been completely analyzed and an additional 72 that have had some contents identified, but that are not completed. Forty-seven percent of the scats were collected directly from animals during handling and 53 percent were collected at fisher rest sites. Frequency of occurrence is the number of scats that included the item at the speed level of taxonomic resolution. For example, "MAMMAL" refers to the number of scats that had remains that could be attributed to mammals, eight of which were from Insectivores.

	<u>Frequency of Occurrence</u> (number of scats)
MAMMAL	100 ¹
Insectivora	8
Talpidae	
Scapanus latimanus	4
Soricidae	
Sorex sp.	4
Rodentia	72
Sciuridae - unknown	5
Spermophilus beecheyi	8
Sciurus griseus	3
Tamiasciurus douglasii	10
Geomyidae	
Thomomys bottae	7
Cricetidae - unknown	3
Neotoma cinerea	1
Cricetinae	
Peromyscus sp. or Reithrodontomys sp.	16
Microtinae	
Microtus sp. or Clethrionomys sp.	8
Carnivora	14
Mustelidae	
Martes sp.	13
Mustela sp.	1
Arriodactyla	6
Cervidae	
Odocoileus hemionus	6
BIRD	58

REPTILES	30
Squamata - unknown	4
Iguanidae	
Sceloporus sp.	2
Elegaria sp.	21
Colubridae/Viperidae - unknown	3
INSECTS	81
ARACHNIDS	1
FRUITS	28
Unknown	10
Ericaceae	
Arctostaphylos sp.	14
Grossulariaceae	
Ribes roezeli	1
Ribes nevadense	3
OTHER	
Woody debris	48
Rock	3
Eggshell	9

¹ excludes Martes sp. hair which was assumed to be fisher hair consumed during grooming.

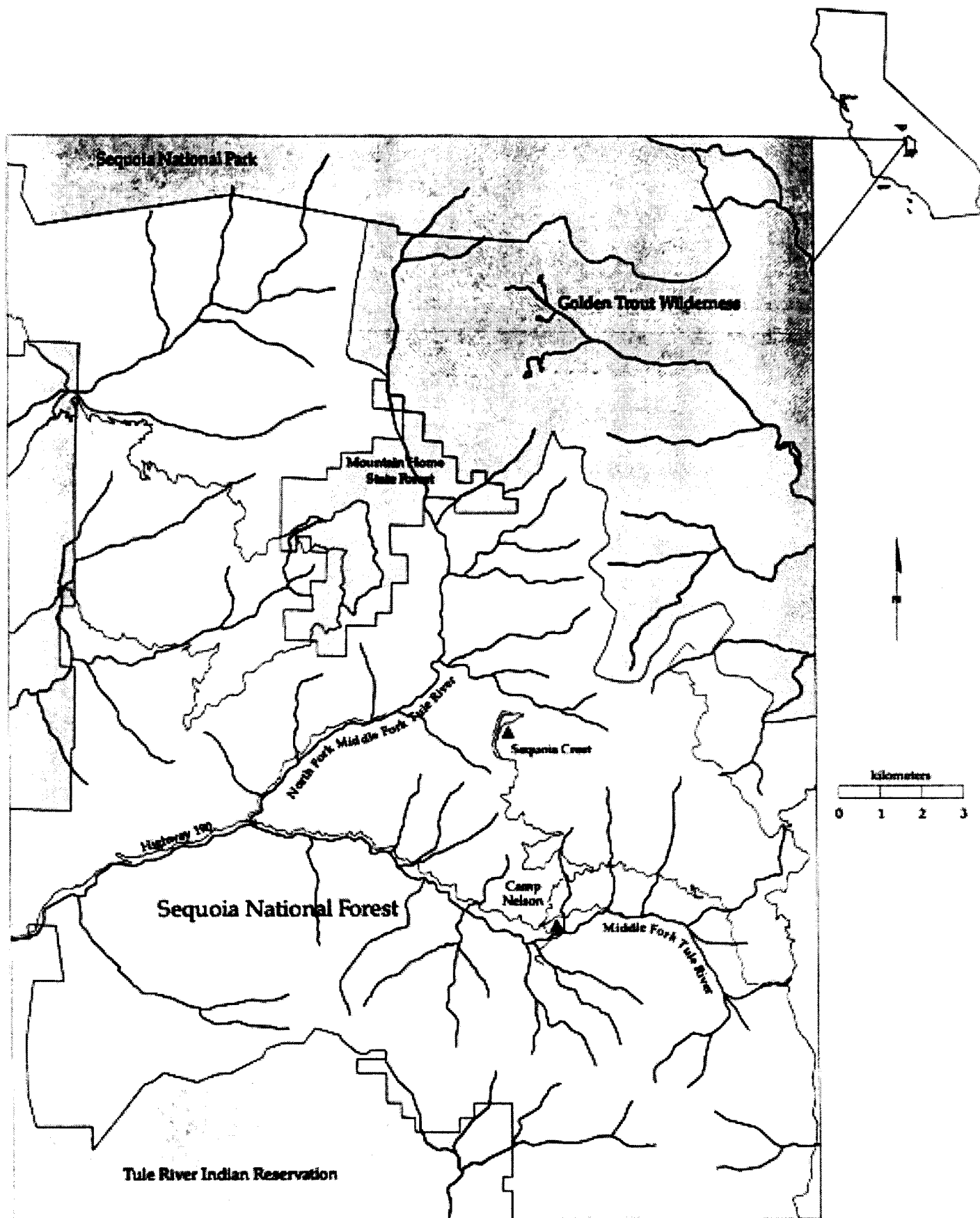


Figure 1. Southern Sierra Nevada Fisher and Marten Study Area, Tulare County, California.

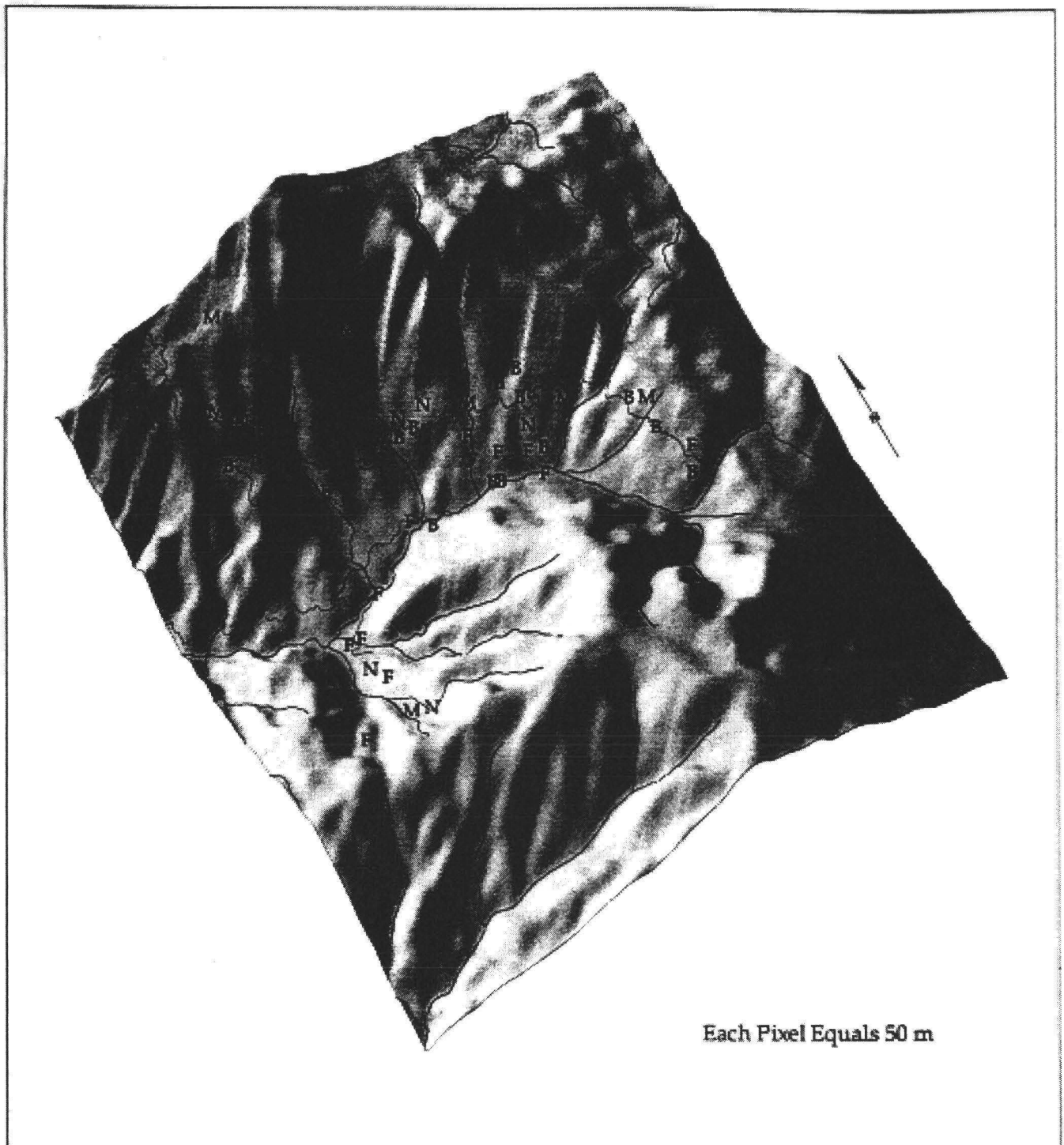


Figure 2. Trap site locations and results for the Camp Nelson area. Map symbols correspond to species captured: B = both marten and fisher, F = fisher only M = marten only, N = neither marten nor fisher captured.

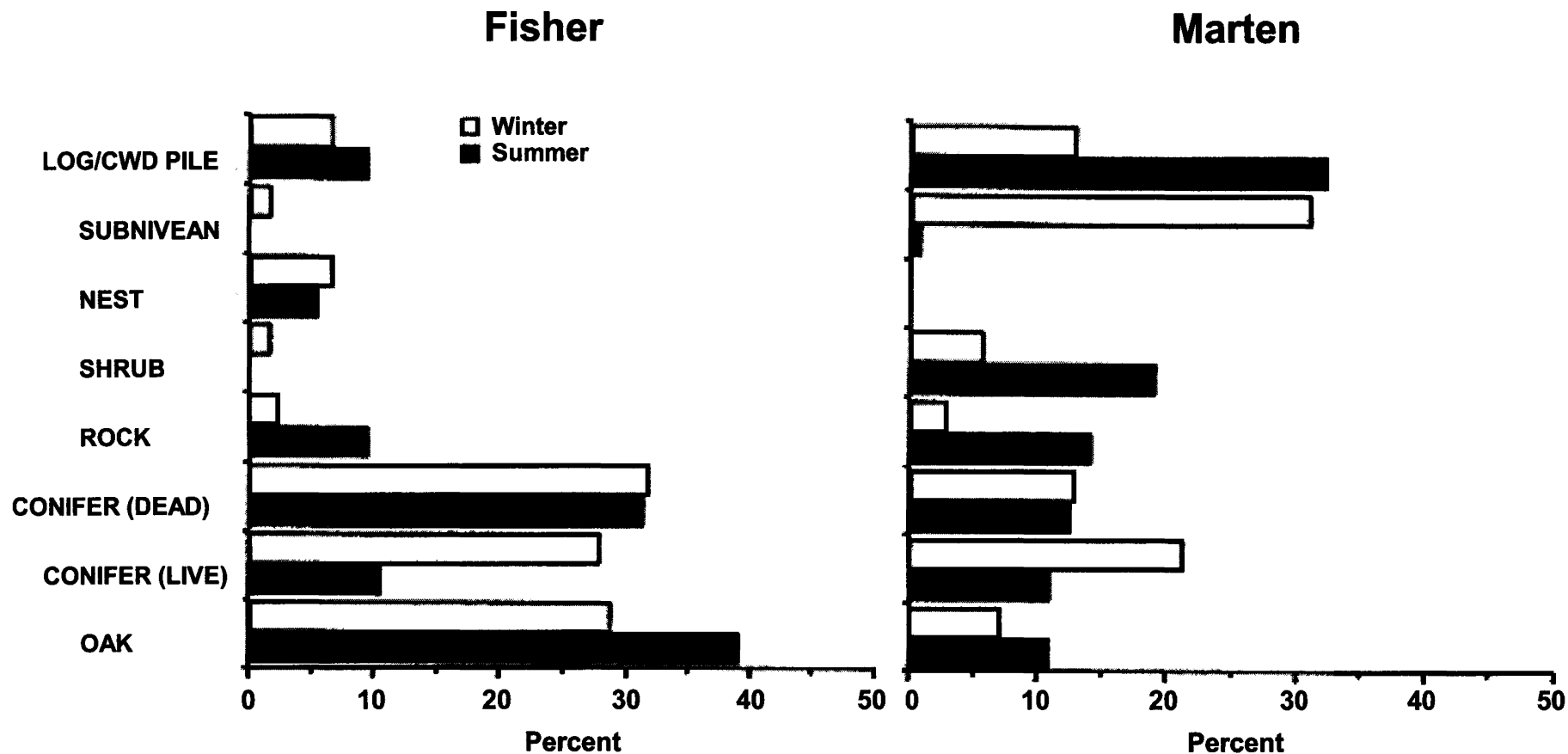


Figure 3. Frequency distribution of rest sites used by fishers and martens during "winter" (snow present) and "summer" (snow-free season) from 13 May 1994 through 2 October, 1996.

CWHR Vegetation Types at Rest Sites

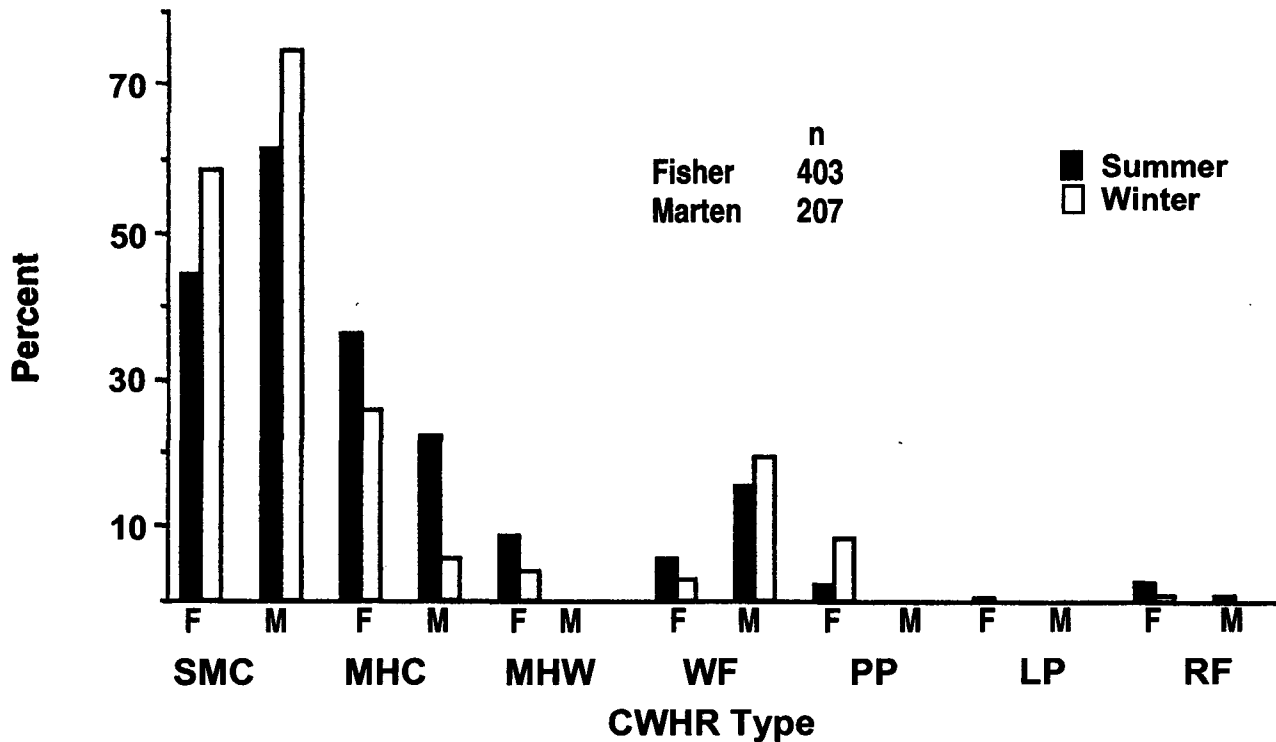


Figure 4. Frequency distribution of California Wildlife Habitat Relationships (CWHR) system types where "winter" (snow season) and "summer" (snow-free season) rest sites were located for fishers and martens from 15 May 1994 - 2 October 1996. SMC = Sierra Mixed Conifer, MHC = Montane Hardwood Conifer, MHW = Montane Hardwood, WF = White Fir, PP = Ponderosa Pine, LP = Lodgepole Pine, and RF = Red Fir.

CWHR Tree Size at Rest Sites

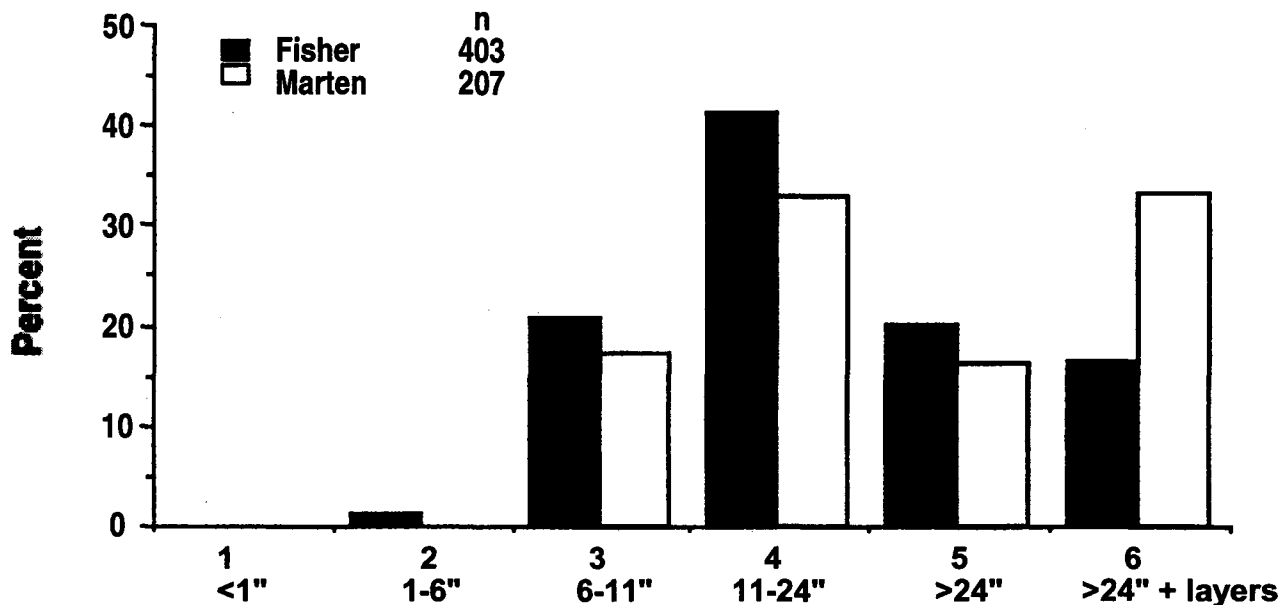
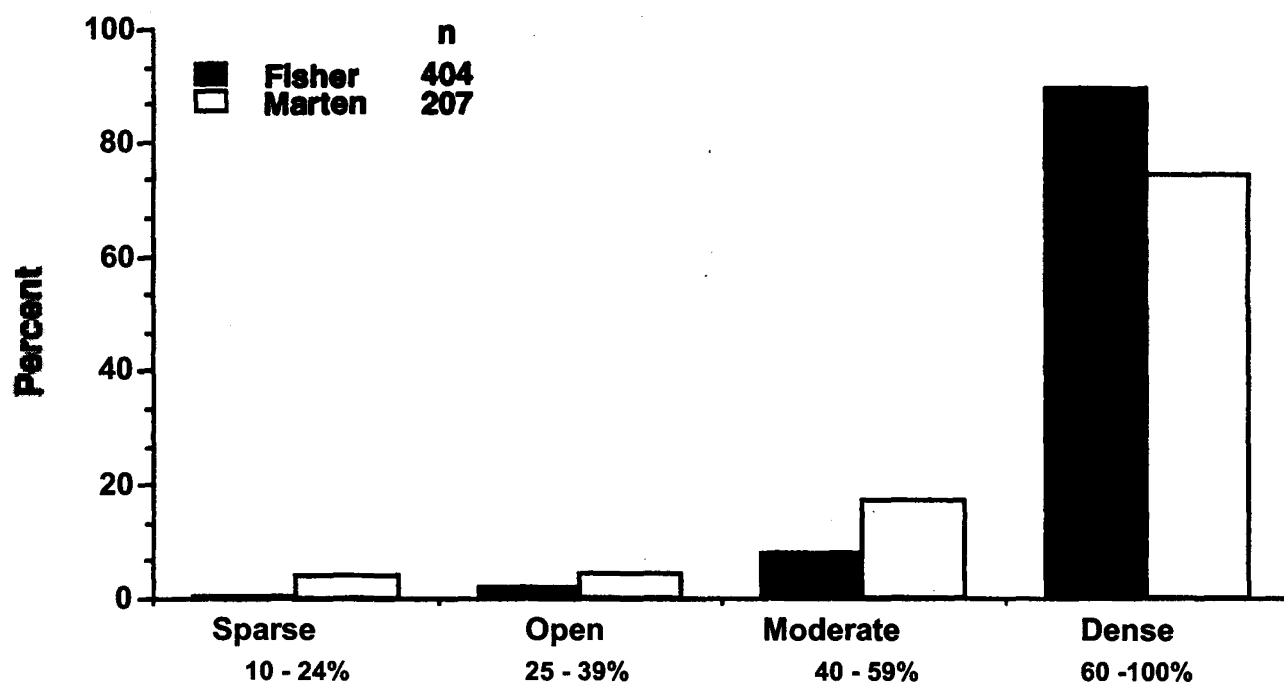


Figure 5. Frequency distribution of CWHR system tree size classes at fisher and marten rest sites from 15 May 1994 - 2 October 1996.

CWHR Canopy Closure at Rest Sites: Total



Summer vs. Winter

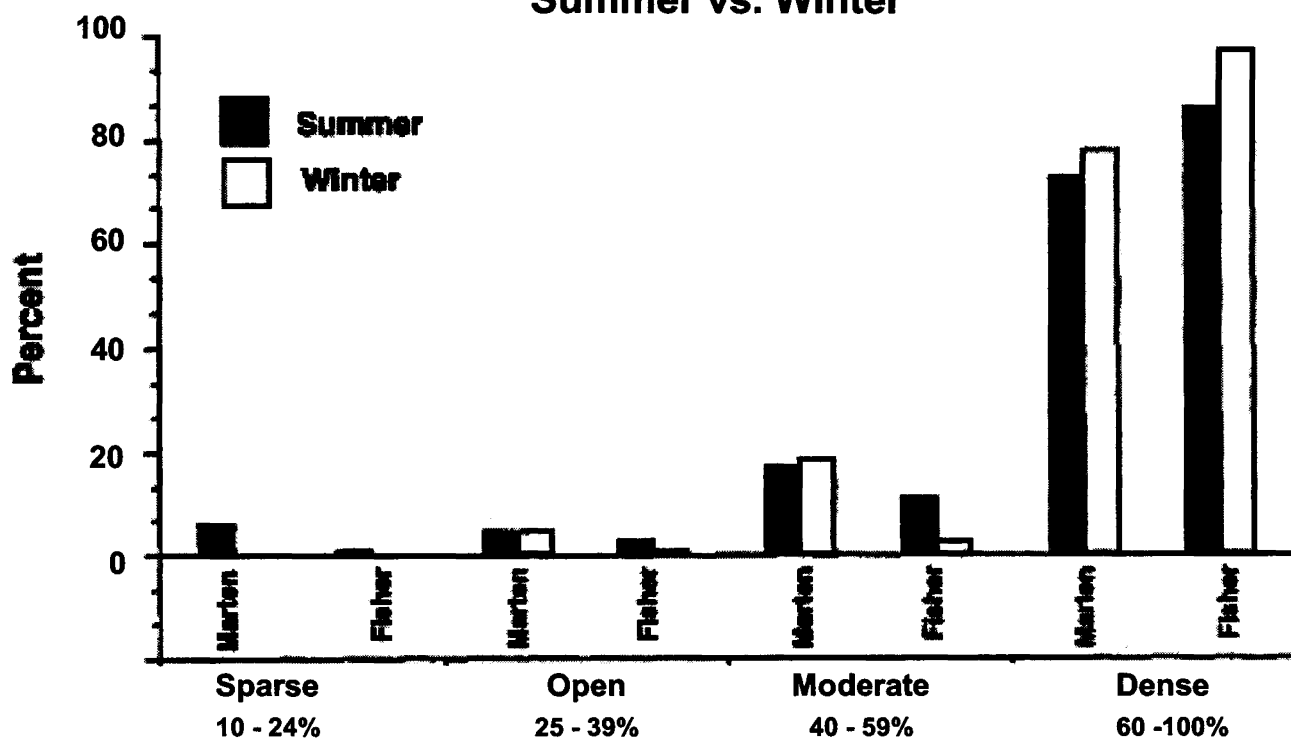


Figure 6. Frequency distribution of CWHR canopy closure classes in vicinity of fisher and marten rest sites, 15 May 1994 - 2 October 1996. Top figure, both seasons combined. Bottom figure, "summer"(snow-free season) compared to "winter" (snow season).

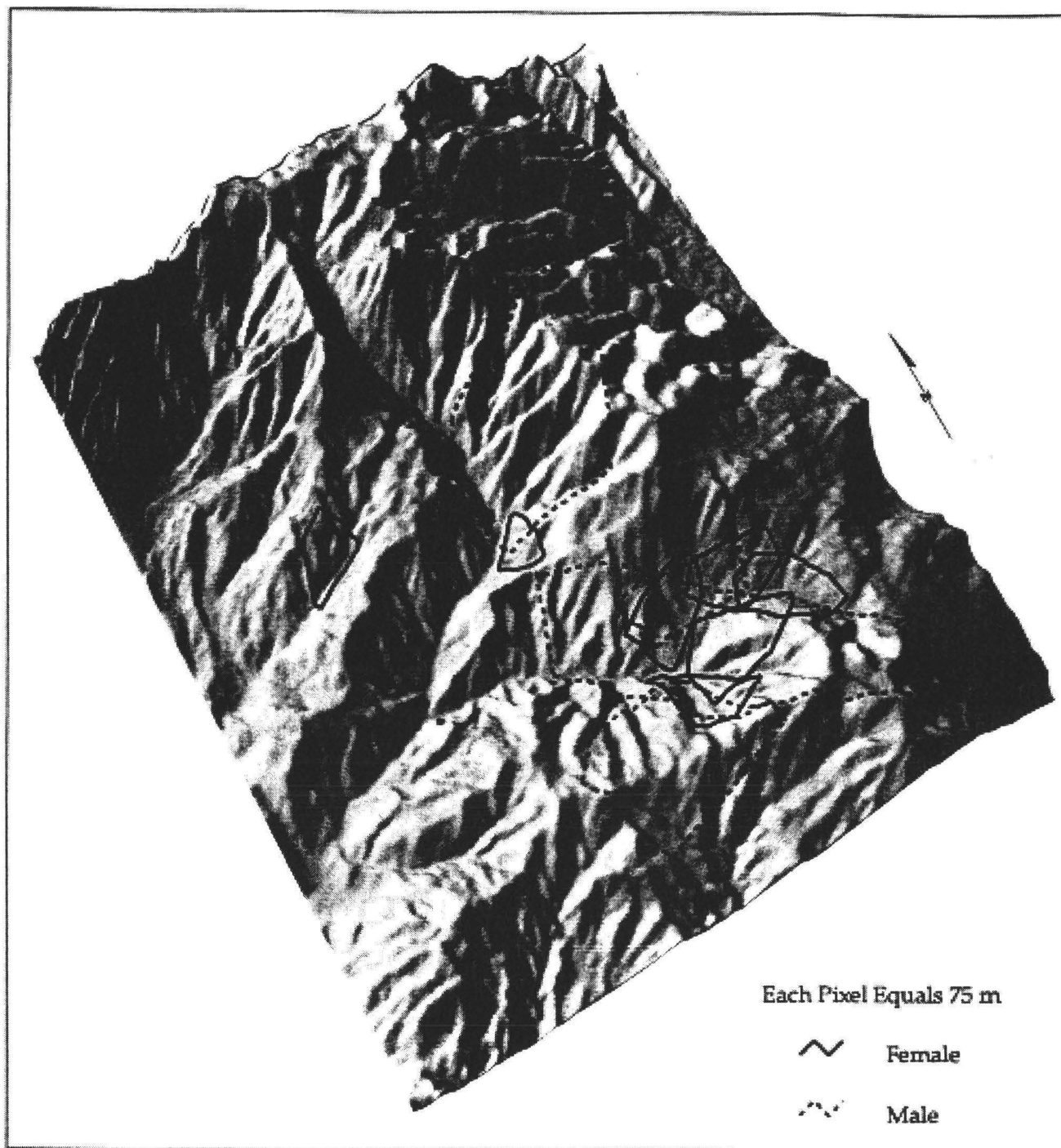


Figure 7. Minimum Convex Polygon home ranges (95% contour) estimated for fishers relocated at least 15 times from May 1994 to August 1996. Females represented here were tracked primarily during 1994 and 1995.

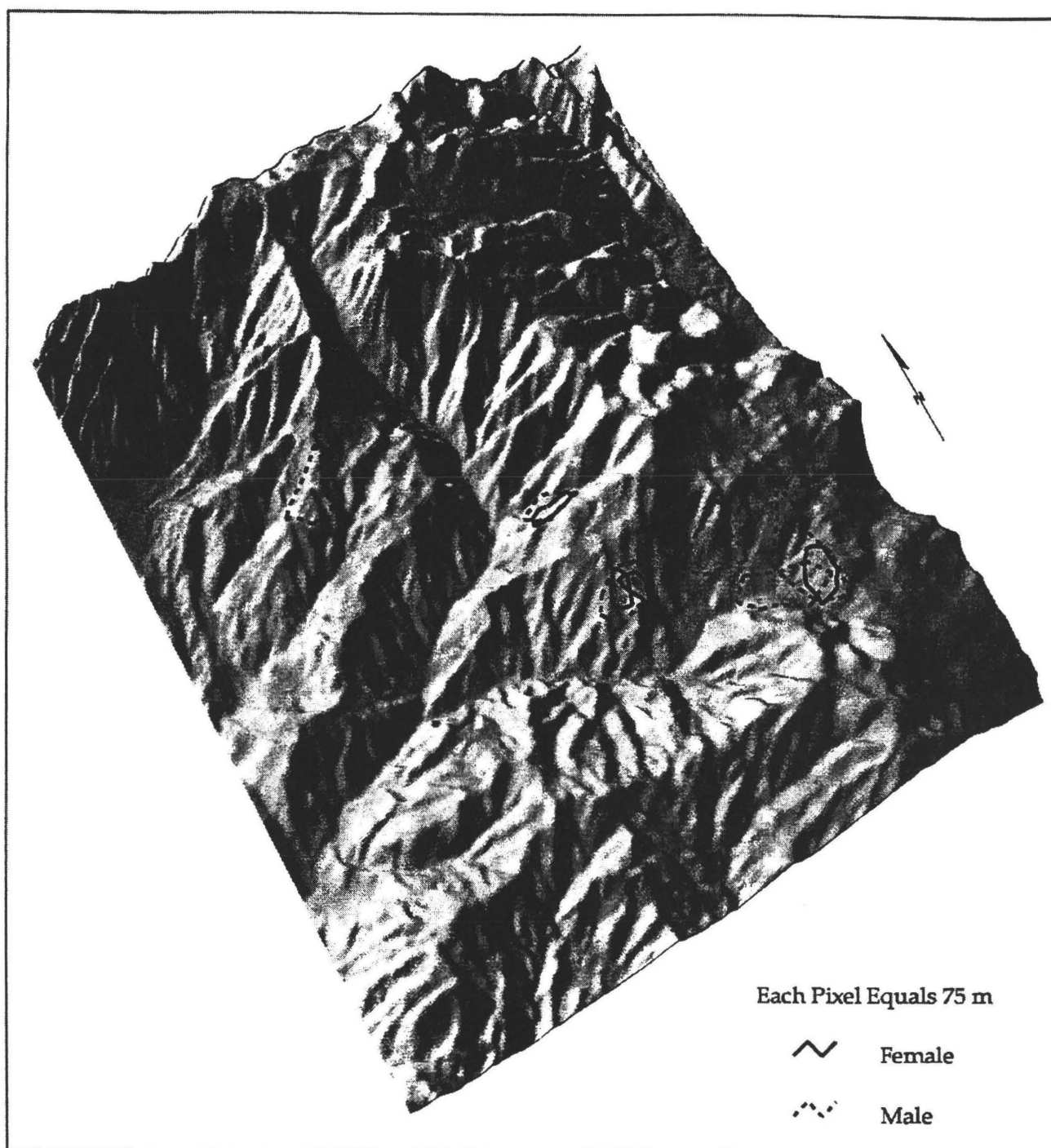


Figure 8. Minimum Convex Polygon home ranges (95% contour) estimated for martens relocated at least 12 times from May 1994 to August 1996.

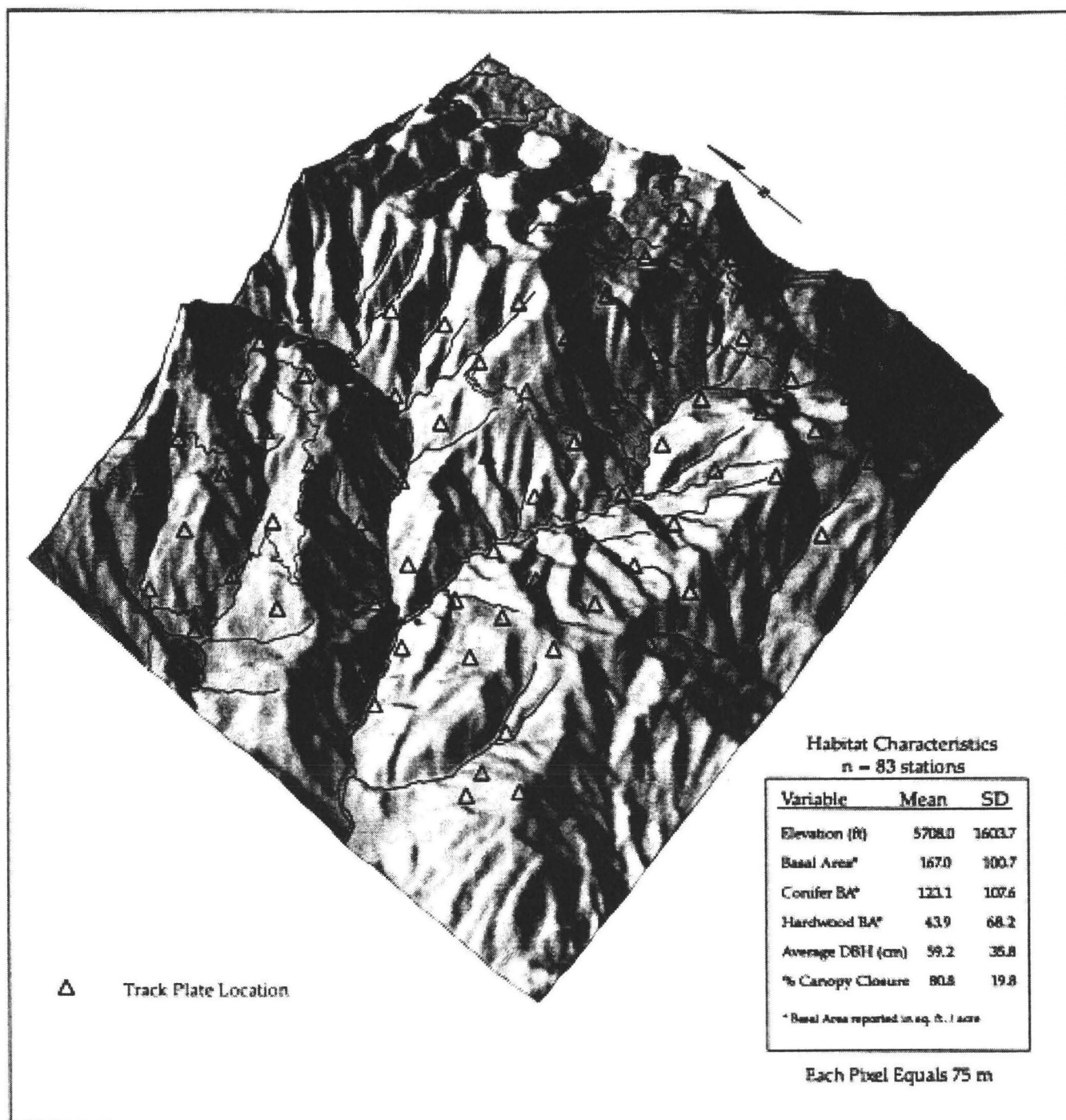


Figure 9. From July to November 1995, 83 track plate stations were placed at 2 km intervals throughout the study area. Track plates ranged in elevation from 2000 to 9000 ft (~ 610 to 2740 m) and occurred in a variety of habitat types including mixed chaparral, montane hardwood, montane hardwood conifer, Sierran mixed conifer, and true fir forests.

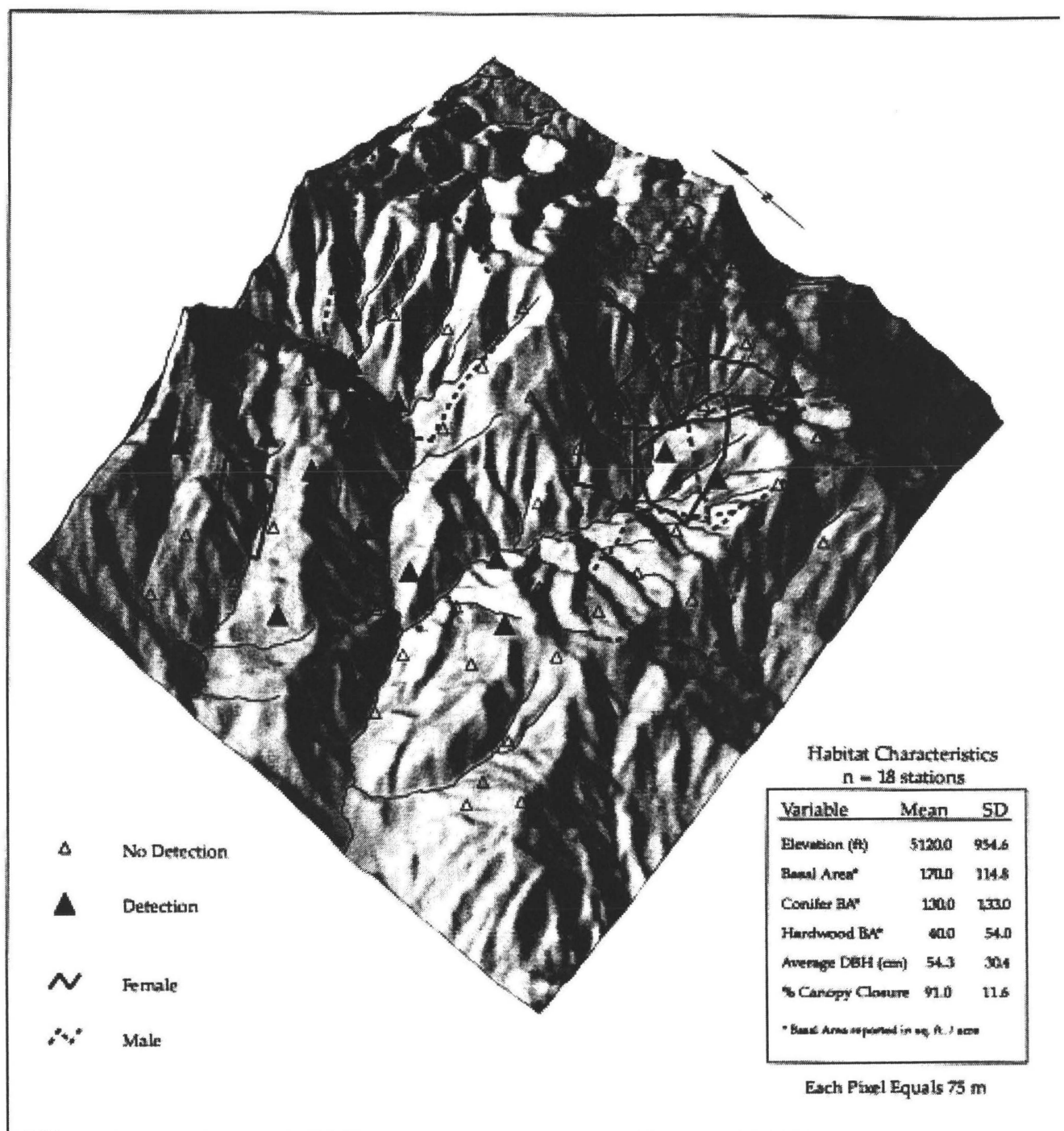


Figure 10. Fishers were detected at 18 stations ranging in elevation from 3680 to 7000 ft (~ 1120 to 2130 m). Home range estimates (95% Minimum Convex Polygon) for animals actively transmittting during the surveys are depicted here.

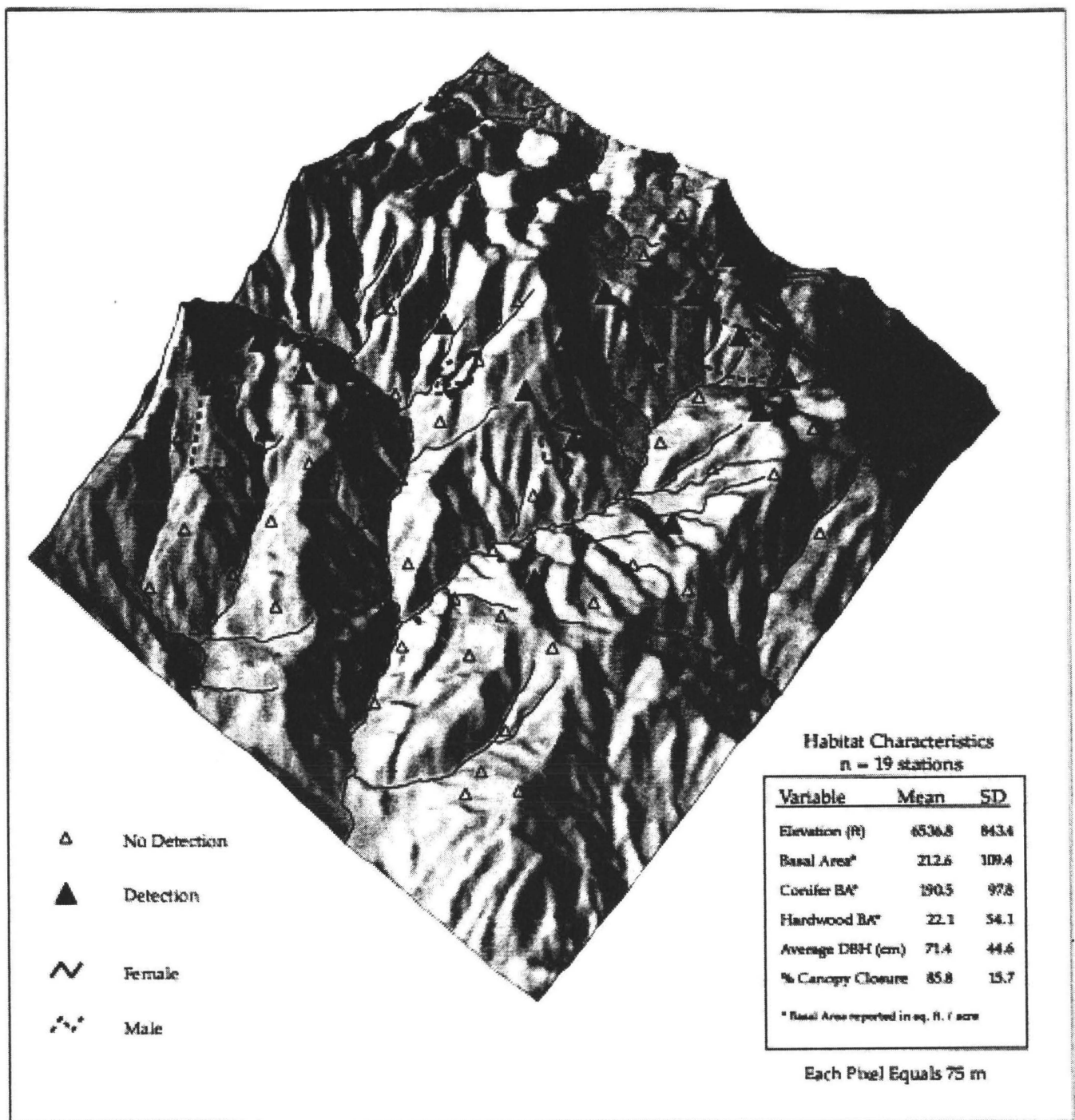
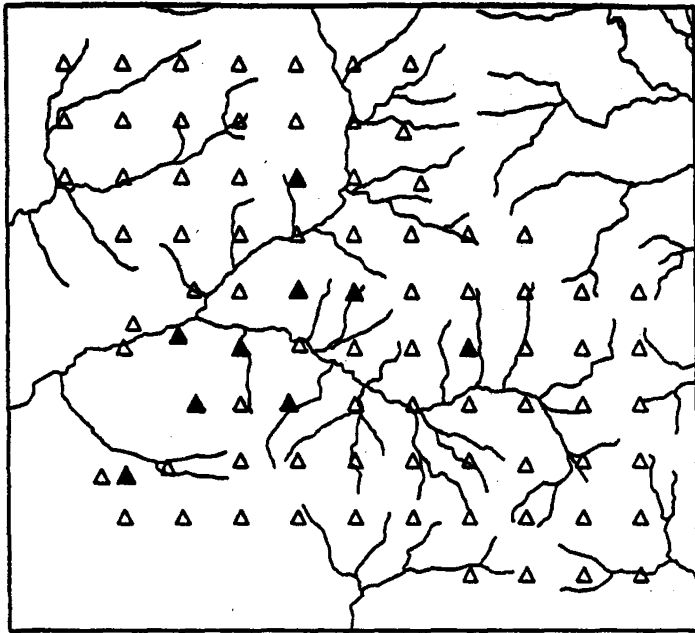
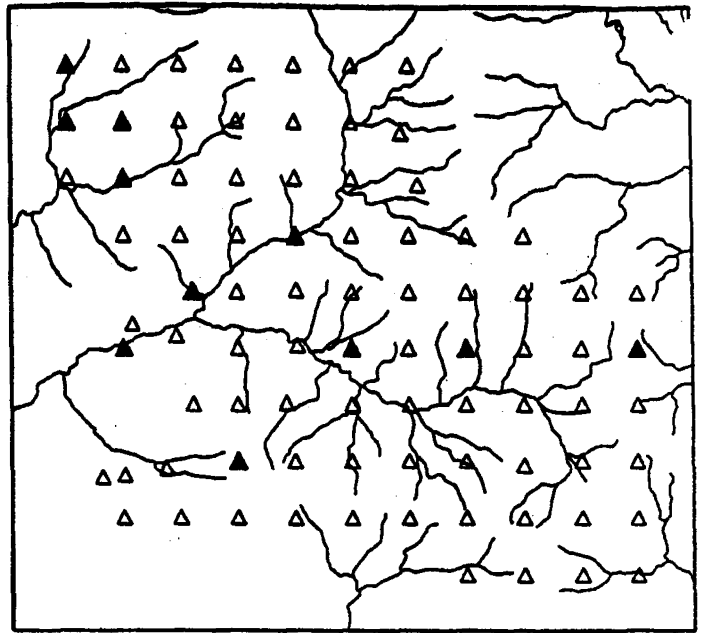


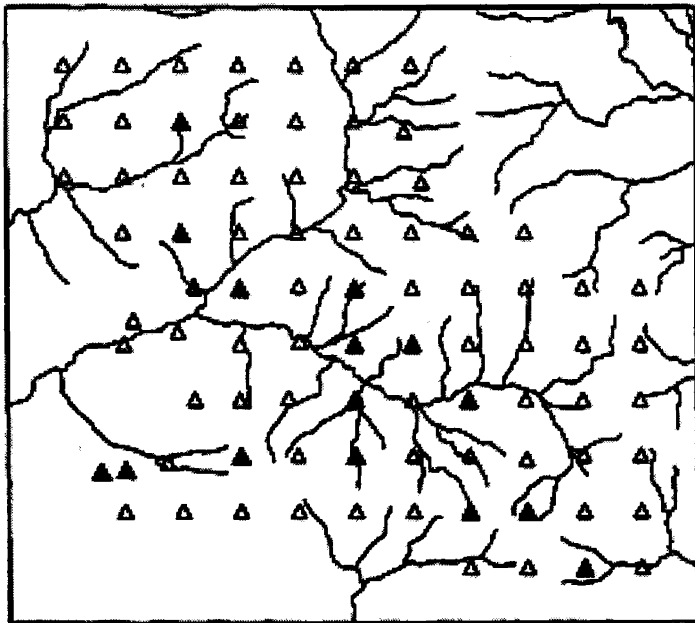
Figure 11. Martens were detected at 19 stations ranging in elevation from 5120 to 7900 ft (~ 1560 to 2400 m). Home range estimates (95% Minimum Convex Polygon) for martens actively transmitting during the surveys are depicted here.



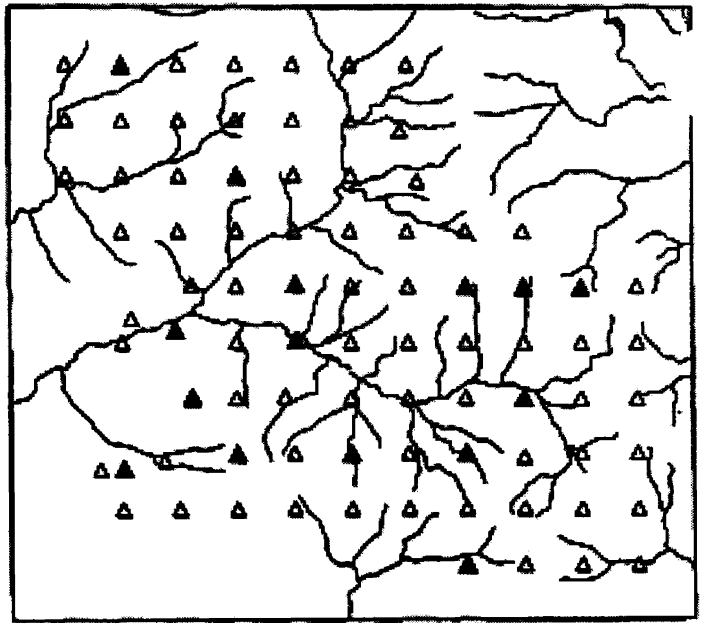
Ringtail
Bassariscus astutus



Spotted Skunk
Spilogale putorius



Gray Fox
Urocyon cinereoargenteus



Black Bear
Ursus americana

Figure 12. In addition to fisher and marten, several other carnivores were detected. The most common were ringtail, spotted skunk, gray fox, and black bear. Black bear detections plotted here include only stations where tracks were recorded; additional sites were damaged and assumed to be due to black bears.